AEROSPACE MATERIAL SPECIFICATION

AMS5895	REV. E

Issued 1979-10
Revised 2009-10
Reaffirmed 2015-04

Superseding AMS5895D

Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings
15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V
Consumable Electrode Melted, 1750 °F (954 °C) Solution Heat Treated, Welding Grade
Precipitation Hardenable
(Composition similar to UNS S66286)

RATIONALE

AMS5895E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Form

This specification covers a corrosion and heat-resistant steel in the form of bars, wire, forgings, mechanical tubing, flash welded rings, and stock for forging, flash welded rings, or heading.

1.2 Application

These products have been used typically for parts requiring high strength up to 1300 °F (704 °C) and oxidation resistance up to 1500 °F (816 °C), particularly those which are welded and then heat treated to develop required properties, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2241 Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS2243 Tolerances, Corrosion and Heat-Resistant Steel Tubing
AMS2248 Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS2371 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloys, Wrought Products and Forging Stock

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5895E

(Continued)
AMS2374 Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steel and Alloy Forgings
AMS2750 Pyrometry
AMS2806 Identification, Bars, Wire, Mechanical Tubing and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys
AMS2808 Identification, Forgings
AMS7490 Rings, Flash Welded, Corrosion and Heat-Resistant Austenitic Steels and Austenitic-Type Alloys

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A 370 Mechanical Testing of Steel Products
ASTM E 112 Determining Average Grain Size
ASTM E 139 Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E 292 Conducting Time-for-Rupture Notch Tension Tests of Materials
ASTM E 353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Carbon	--	0.08
Manganese	--	0.35
Silicon	--	0.30
Phosphorus	--	0.020
Sulfur	--	0.010
Chromium	13.50	16.00
Nickel	24.00	27.00
Molybdenum	1.00	1.50
Titanium	1.90	2.35
Boron	0.0030	0.010
Vanadium	0.10	0.50
Cobalt	--	1.00
Aluminum	--	0.35
Copper	--	0.50

3.1.1 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

3.2 Melting Practice

Steel shall be produced by multiple melting using consumable electrode practice in the remelt cycle.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars, Wire, Forgings, and Flash Welded Rings

Solution heat treated.

3.3.1.1 Bars and Wire

3.3.1.1.1 All hexagons, other bars 2.750 inches (69.85 mm) and under in nominal diameter or least distance between parallel sides, and wire shall be cold finished.

3.3.1.1.2 Bars, other than hexagons, over 2.750 inches (69.85 mm) in nominal diameter or least distance between parallel sides shall be hot finished and descaled, or cold finished.

3.3.1.2 Forgings

Shall be descaled.

3.3.1.3 Flash Welded Rings

Shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, rings shall be manufactured in accordance with AMS7490.

3.3.1.4 Mechanical Tubing

Cold finished.

3.3.2 Stock for Forgings, Flash Welded Rings, or Heading

As ordered by the forging, flash welded ring, or heading manufacturer.

3.4 Heat Treatment

Bars, wire except as specified in 3.4.1, forgings, mechanical tubing, and flash welded rings shall be solution heat treated by heating to 1750 °F ± 25 (954 °C ± 14), holding at heat for not less than 1 hour, and quenching in oil or water. Pyrometry shall be in accordance with AMS2750.

3.4.1 Wire 0.1874 inch (4.760 mm) and under in nominal diameter shall be solution heat treated by heating to 1750 °F ± 25 (954 °C ± 14), holding at heat for a time commensurate with wire diameter, and cooling rapidly.

3.5 Properties

The product shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A 370:

3.5.1 Bars, Wire, Forgings, Mechanical Tubing, and Flash Welded Rings

3.5.1.1 As Solution Heat Treated

3.5.1.1.1 Tensile Properties

Wire shall have tensile strength not higher than 105 ksi (724 MPa) or equivalent hardness (See 8.2).

3.5.1.1.2 Hardness

3.5.1.1.2.1 Bars and Mechanical Tubing

Not higher than 201 HB, or equivalent, (See 8.3) determined approximately midway between outer surface and center or inner surface as applicable.

3.5.1.1.2.2 Forgings and Flash Welded Rings

Not higher than 201 HB, or equivalent (See 8.3).

3.5.1.1.3 Average Grain Size

Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.5.1.2 After Precipitation Heat Treatment

Product, 5.0 inches (127 mm) and under in nominal diameter or least distance between parallel sides, shall have the following properties after being precipitation heat treated by heating to 1325 °F ± 15 (718 °C ± 8), holding at heat for not less than 16 hours, and cooling in air.

3.5.1.2.1 Longitudinal Tensile Properties

Shall be as shown in Table 2.

TABLE 2 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	130 ksi (896 MPa)
Yield Strength at 0.2% Offset	85 ksi (586 MPa)
Elongation in 4D	15%
Reduction of Area	20%

3.5.1.2.1.1 The requirements of 3.5.1.2.1 apply to specimens taken with the axis approximately parallel to the grain flow and to specimens taken in the radial direction and in the tangential direction at the rim of disc forgings.

3.5.1.2.1.2 Specific locations of specimens from forgings and flash welded rings shall be as agreed upon by purchaser and vendor.

3.5.1.2.2 Hardness

Should be 248 to 341 HB, or equivalent (See 8.3). The product shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.1.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness, or from another sample with similar nonconforming hardness.

3.5.1.2.3 Stress-Rupture Properties at 1200 °F (649 °C)

Shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be performed in accordance with ASTM E 292 and of smooth specimens in accordance with ASTM E 139:

3.5.1.2.3.1 A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E 292, maintained at 1200 °F ± 3 (649 °C ± 2) while a load sufficient to produce an initial axial stress of 65.0 ksi (448 MPa) is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Rupture shall occur in the smooth section and elongation of this section after rupture, measured at room temperature, shall be not less than 5 percent in 4D if the specimen ruptures in 48 hours or less and not less than 3 percent in 4D if the specimen ruptures in more than 48 hours.

3.5.1.2.3.2 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece with gage sections conforming to the applicable dimensions shown in ASTM E 292, may be tested individually under the conditions of 3.5.1.2.3.1. The smooth specimen shall not rupture in less than 23 hours and elongation after rupture, measured at room temperature, shall be as specified in 3.5.1.2.3.1. The notched specimen shall not rupture in less time than the companion smooth specimen but need not be tested to rupture.

3.5.1.2.3.3 The tests of 3.5.1.2.3.1 and 3.5.1.2.3.2 may be conducted using a load higher than required to produce an initial axial stress of 65.0 ksi (448 MPa) but the load shall not be changed while test is in progress. Time to rupture, rupture location, and elongation requirements shall be as specified in 3.5.1.2.3.1.

3.5.1.2.3.4 The tests of 3.5.1.2.3.1 and 3.5.1.2.3.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 65.0 ksi (448 MPa) shall be used to rupture or for 23 hours, whichever occurs first. After the 23 hours and at interval of 8 hours minimum, thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture, rupture location, and elongation requirements shall be as specified in 3.5.1.2.3.1.

3.5.1.2.3.5 For tubing from which a solid round specimen cannot be cut, a full section of tubing shall be tested and shall meet the smooth bar requirements of 3.5.1.2.3.1.

3.5.2 Forging Stock

When a sample of stock is forged to a test coupon and heat treated as in 3.4 and 3.5.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3. If specimens taken from the stock after heat treatment as in 3.4 and 3.5.1.2 conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5.3 Stock for Flash Welded Rings or Heading

A sample of stock heat treated as in 3.4 and 3.5.1.2 shall conform to the requirements of 3.5.1.2.1, 3.5.1.2.2, and 3.5.1.2.3.

3.6 Quality

The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6.1 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.7 Tolerances

3.7.1 Bars and Wire

In conformance with AMS2241.

3.7.2 Mechanical Tubing

In conformance AMS2243.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Tensile properties (3.5.1.1.1) of each lot of wire as solution heat treated.

4.2.1.3 Hardness (3.5.1.1.2) of each lot of bars, forgings, mechanical tubing, and flash welded rings as solution heat treated.

4.2.1.4 Tensile properties (3.5.1.2.1), hardness (3.5.1.2.2), and stress-rupture properties (3.5.1.2.3) of each lot of bars, wire, forgings, mechanical tubing, and flash welded rings after precipitation heat treatment.

4.2.1.5 Tolerances (3.7) of bars, wire, and mechanical tubing.

4.2.2 Periodic Tests

Tests for forging stock (3.5.2) and of stock for flash welded rings or heading (3.5.3) to demonstrate ability to develop required properties, and grain flow of die forgings (3.6.1) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

4.3.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.3.2 Forgings

In accordance AMS2374.

4.4 Reports

The vendor of the product shall furnish with each shipment a report showing the results of tests for composition of each heat and for tensile properties and hardness solution heat treated and for tensile properties, hardness, and stress-rupture properties after precipitation heat treatment of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS5895E, size, product form, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.5 Resampling and Retesting

4.5.1 Bars, Wire, Mechanical Tubing, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading

In accordance with AMS2371.

4.5.2 Forgings

In accordance with AMS2374.